

Benefits of Distributed Energy to the US (and planet earth)

DER – The Power to Choose

November 28, 2001

Thomas R. Casten Chairman & CEO

Private Power, November 28, 2001

20,000 Foot View

**Energy policy focuses on fuel supply
and on efficient use of electricity and
steam, but:**

**The conversion of fuel to electricity
and steam and electric transmission
& distribution is not optimal**

Three Stages of Energy

1) Find and extract fuel	2) Convert fuel to carrier energy – move to users	3) Convert carrier energy to end use energy
Extract coal, oil, gas, biomass, sun, wind	Electricity, steam, hot & chilled water	Lighting, process heat & power, space conditioning
Competitive, Highly efficient 28% imported	Monopoly 2/3's waste Barriers to efficiency	Competitive Improving

Power Failure Headlines

- **California blackouts**
- **Gas prices tripled in 2001**
- **Ice storm downs Quebec and N. England**
- **NYC and Chicago blackouts, '98 & 2000**
- **Power price spikes in 1998, 2001**
- **PG & E declares bankruptcy**
- **Environmental problems – acid rain, smog, global climate change**

Power Problem #1 – Transmission

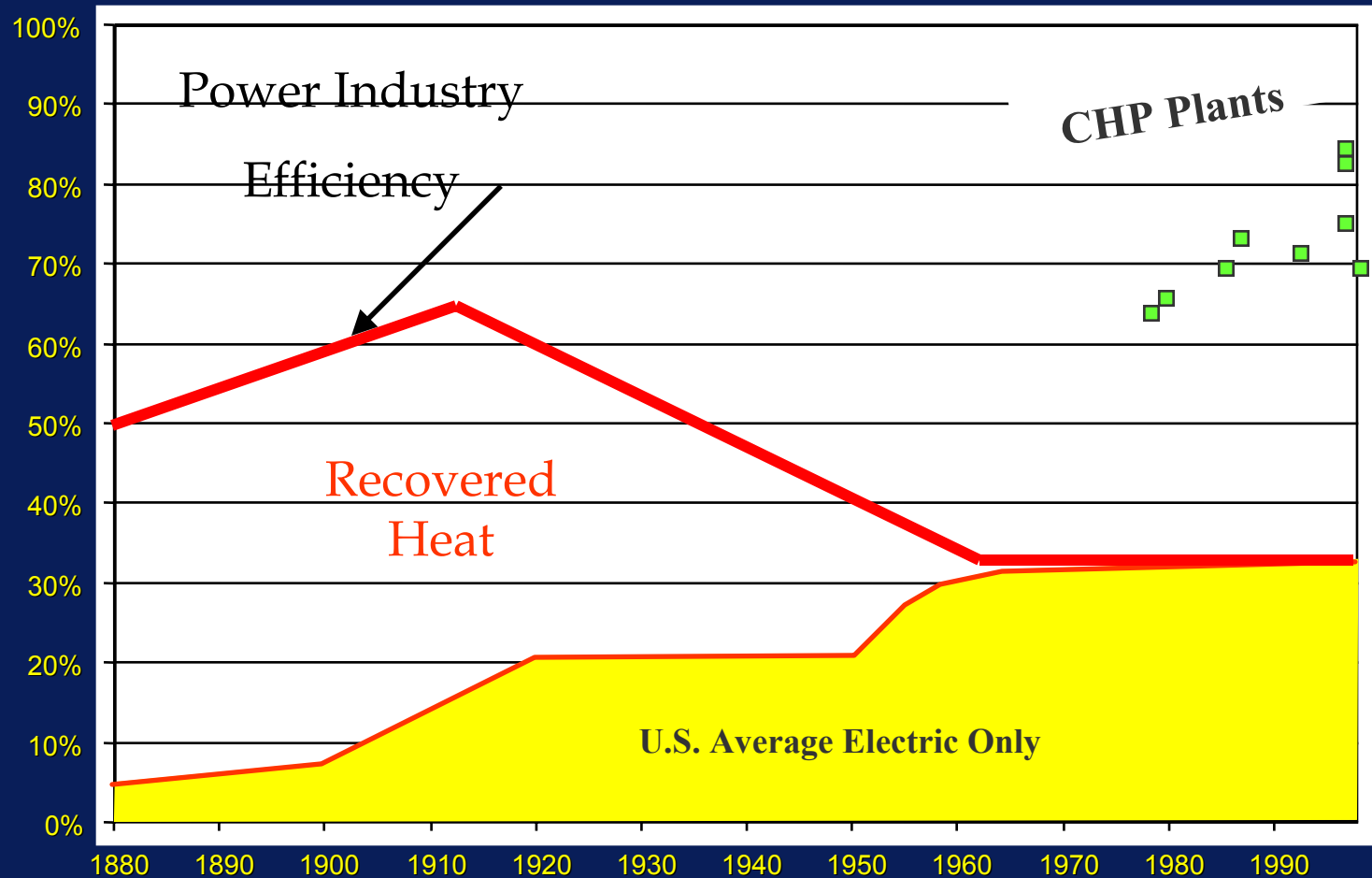
- **Many power failures were T&D related**
- **The US is running out of transmission and distribution capacity (T&D)**
 - **Load grew 22% in decade, T&D grew 4%**
 - **Very difficult to build, everyone detests**
- **Not sure to recover investment**
- **Central generation T&D loss = 7.6%, distributed generation loss = 0% to 3%.**

Power Problem #2

Failure to Recycle Heat

- **US wastes**
 - 1) heat from generation,
 - 2) heat from industrial processes and
 - 3) waste fuel

Energy Generation Efficiency Curve



US Can Recycle Energy with DER

- **Add backpressure turbines to all steam systems, extract power from pressure drop at 82% efficiency**
- **Convert waste heat and flared gas to power**
- **Generate base thermal needs with CHP, increasing efficiency and lowering costs**
- **Purchase heat from existing central plants**

Power Problem #3

Inadequate Power Quality

- **System built for yesterday's industry – where humans controlled machines**
- **Computer chips need 99.9999% availability**
 - **Best reliability from grid, in theory is 99.999%, best practically is 99.99%**
 - **DG primary and secondary supply with tertiary supply from grid can achieve six nines reliability**
 - **Explore some DG to power your computer control loads, with grid backup**

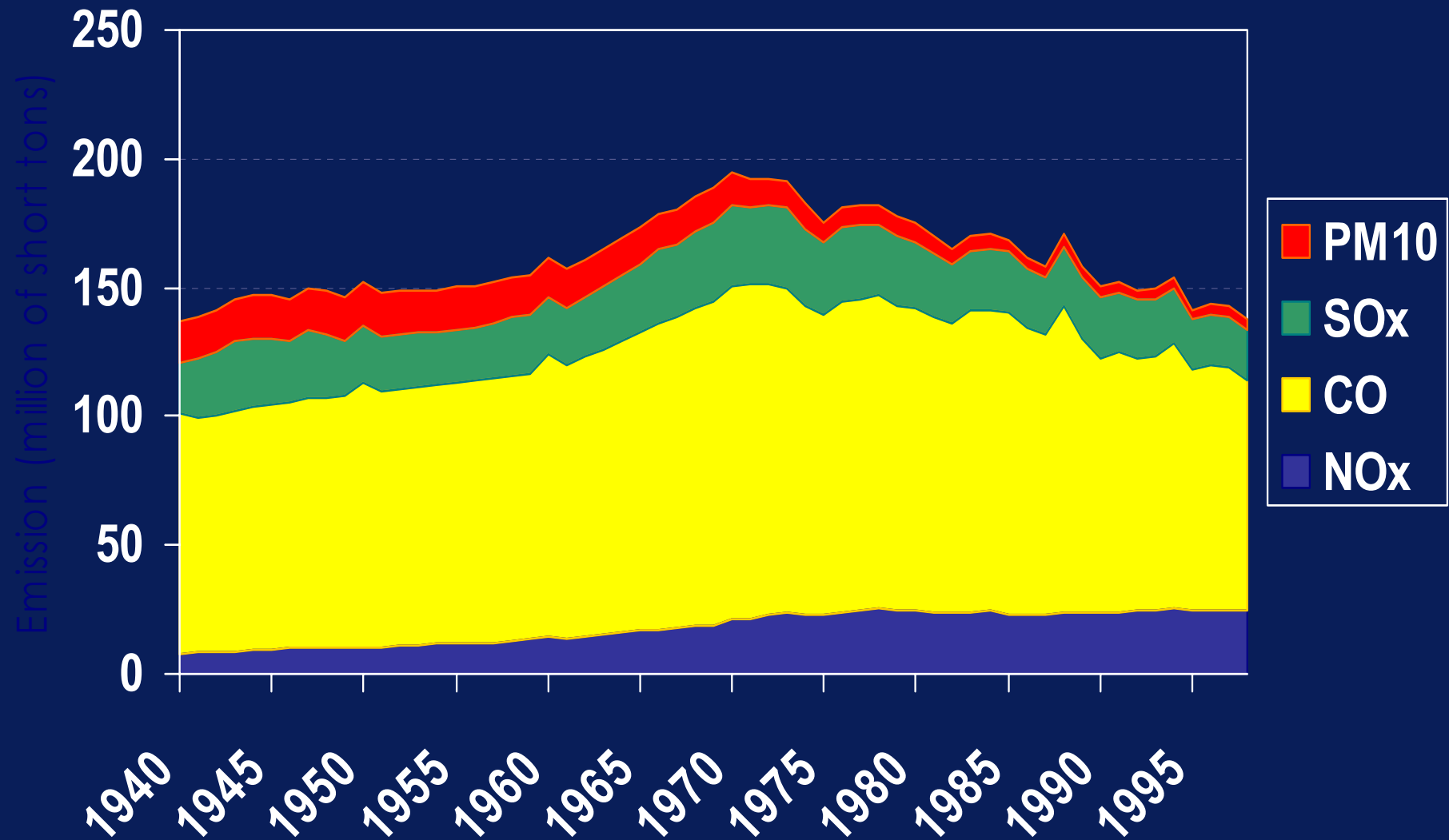
Electric Power Research Institute Findings

- **Power quality cost US \$119 billion in 1999**
- **This compares to total paid for electricity of \$229 billion, is a hidden“tax” of more than 50%**
- **EPRI solution – move to hybrid system with distributed generation backed up by grid power for critical needs.**

Power Problem #4 – Regulated Pollutant Emissions

- **Total emissions are back to 1940 levels, in spite of economy growing 8.5 times.**
- **But EPA regulations are expensive and cause problems.**
 - **Existing plants given no incentive to improve.**
 - **Burden of air cleanup all on new plants, giving them competitive disadvantage.**

Million Tons U.S. Pollutants



Collateral Issues

- **System vulnerability**
- **Balance of payments**
- **Global Warming**
- **Price of power**

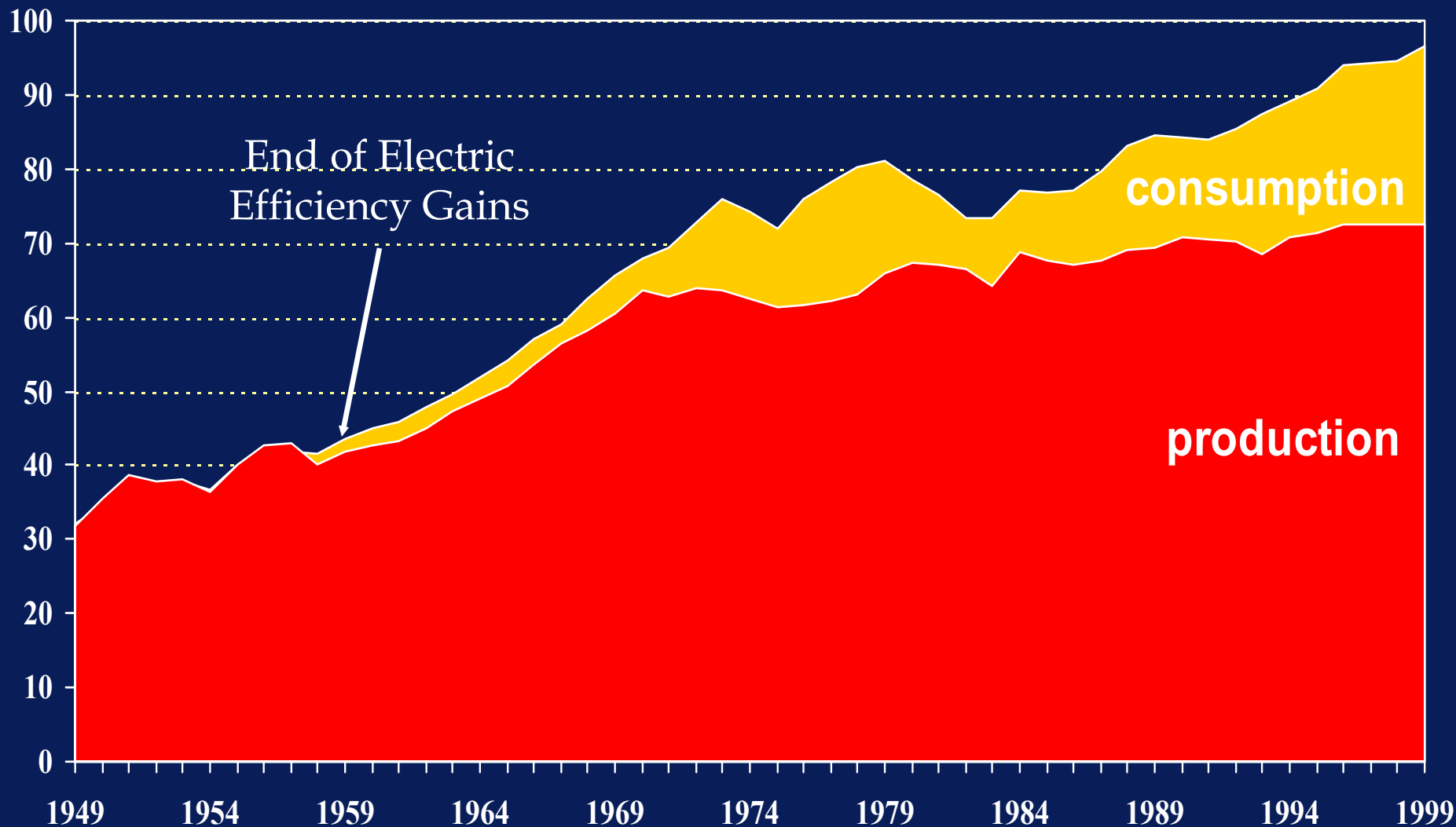
Collateral Issue #1 – System Vulnerability

- Each city depends on a few large transformers, weeks to repair
- Without interconnected DG inside city, knocking out transformers would cause all buildings to lose power until repair
- Can harden transformers, but transmission lines will remain vulnerable.
- **Solution -- interconnect & parallel standby generation and DG to lower vulnerability**

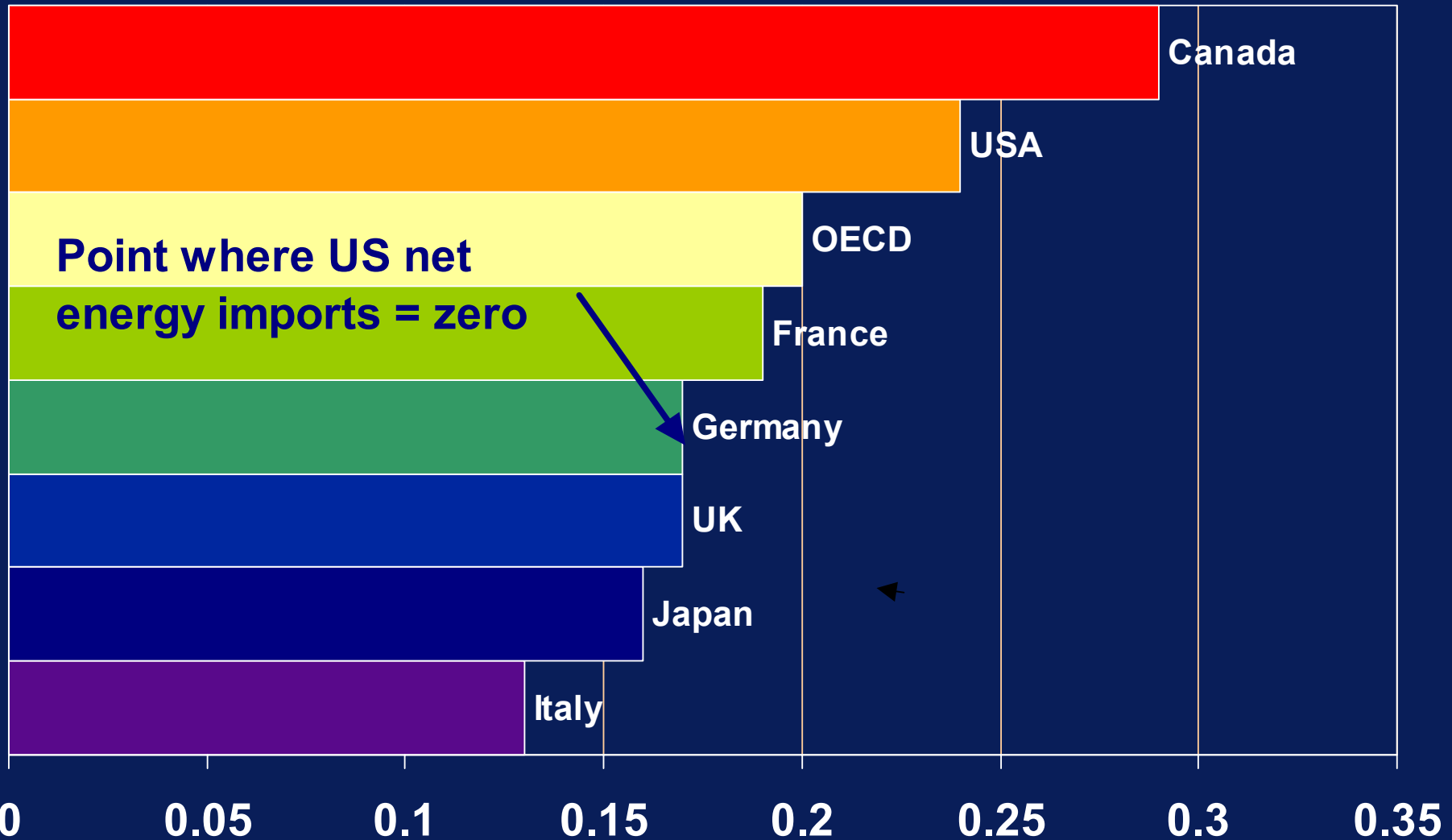
Collateral Issue #2 – Balance of Payments

- **Heat and power use 68% of all US energy**
- **We now import 28% of primary energy**
- **Cost of imports \$1.7 trillion since 1959**

US Production and Consumption of Energy (Quads)



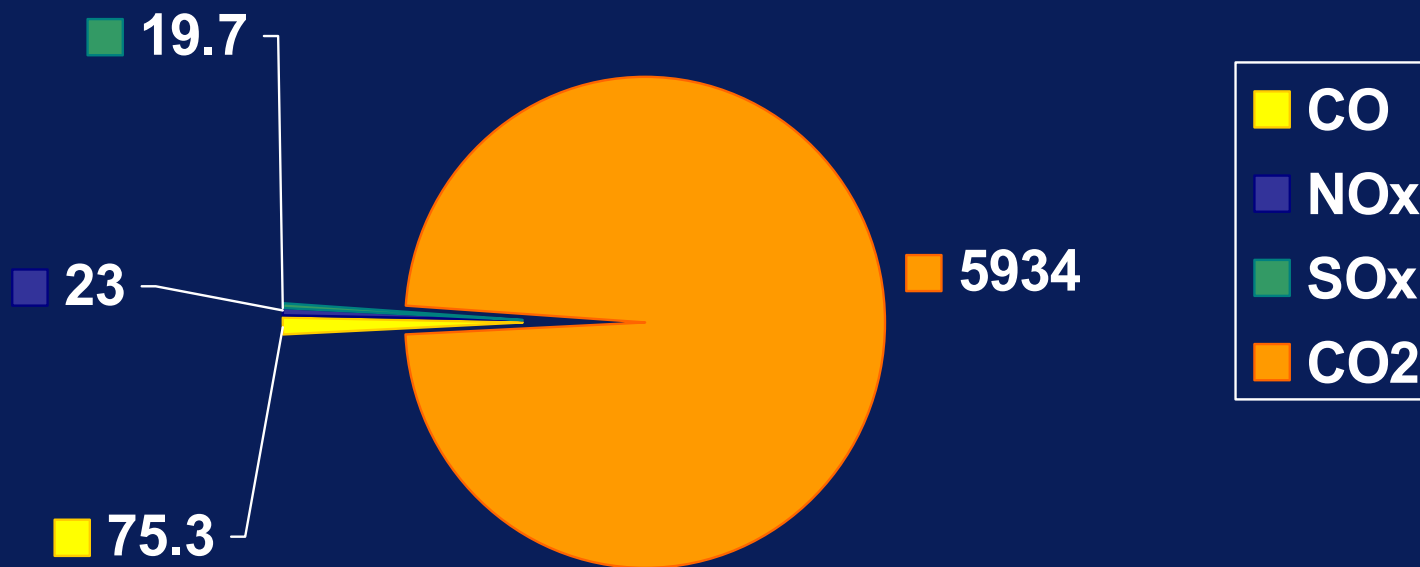
1999 Primary Energy/1000\$GDP



Collateral Issue #3 – Global Warming

- Carbon dioxide is a greenhouse gas,
- CO₂ up 32% since industrial revolution, highest atmospheric concentration in 420,000 years
 - Since 1980, 15 of 16 warmest years since thermometers were widely available
 - Global temperature up 1 degree F in 20 years, 1998 was the warmest year in last millennia
- CO₂ natural & inevitable product of combustion
 - Volume emitted is 50 times total NO_x, Sox, PM, & CO
 - No end-of-pipe way to economically capture CO₂
 - **Only feasible control strategy -- efficiency**

Million Tons U.S. Pollutants from Fuel Combustion, 1998



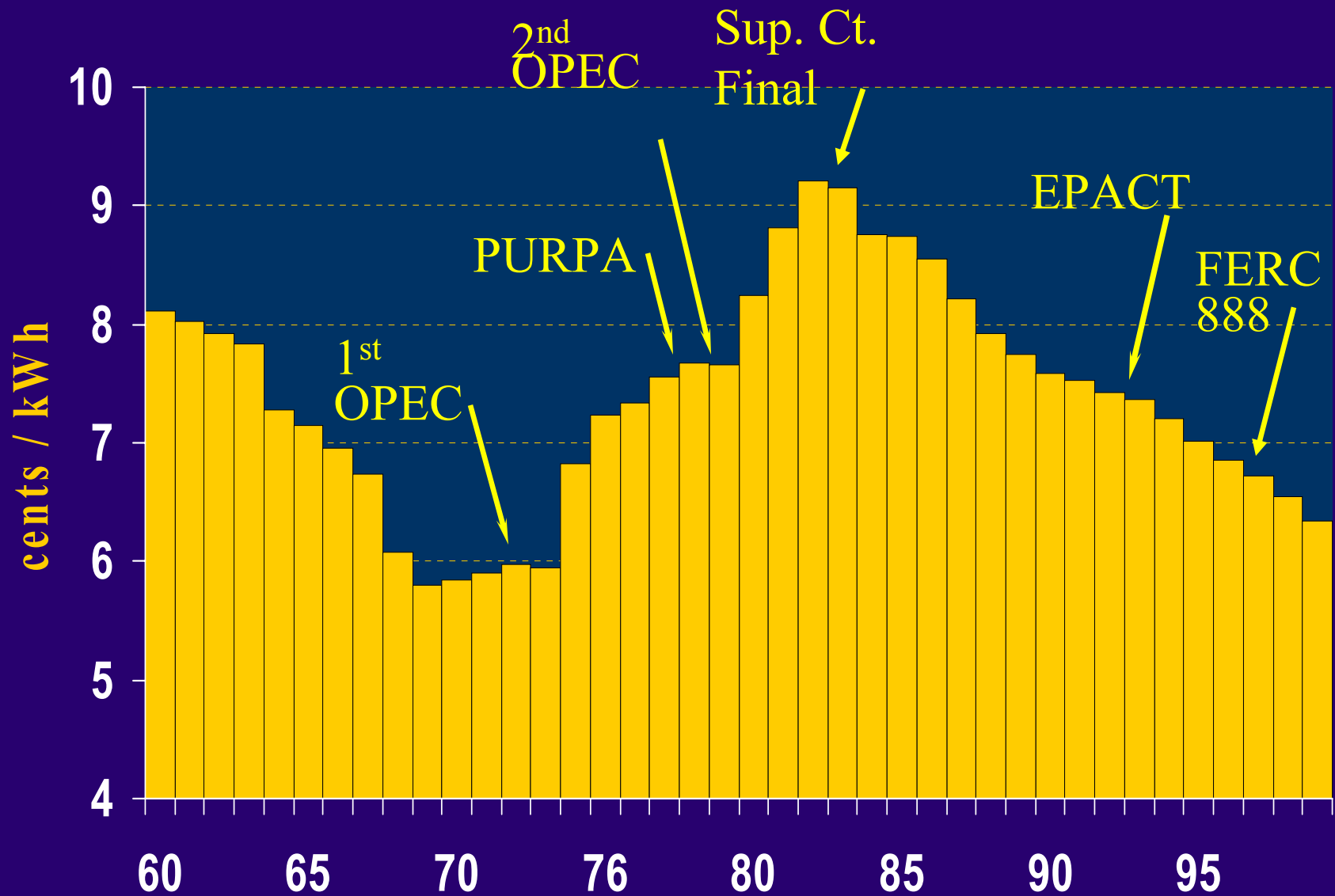
Total = 118

CO₂ 50 times all others

Collateral Issue #4– Power Price

Modest deregulation has spurred seventeen years of price reductions, 32% total reduction since 1984

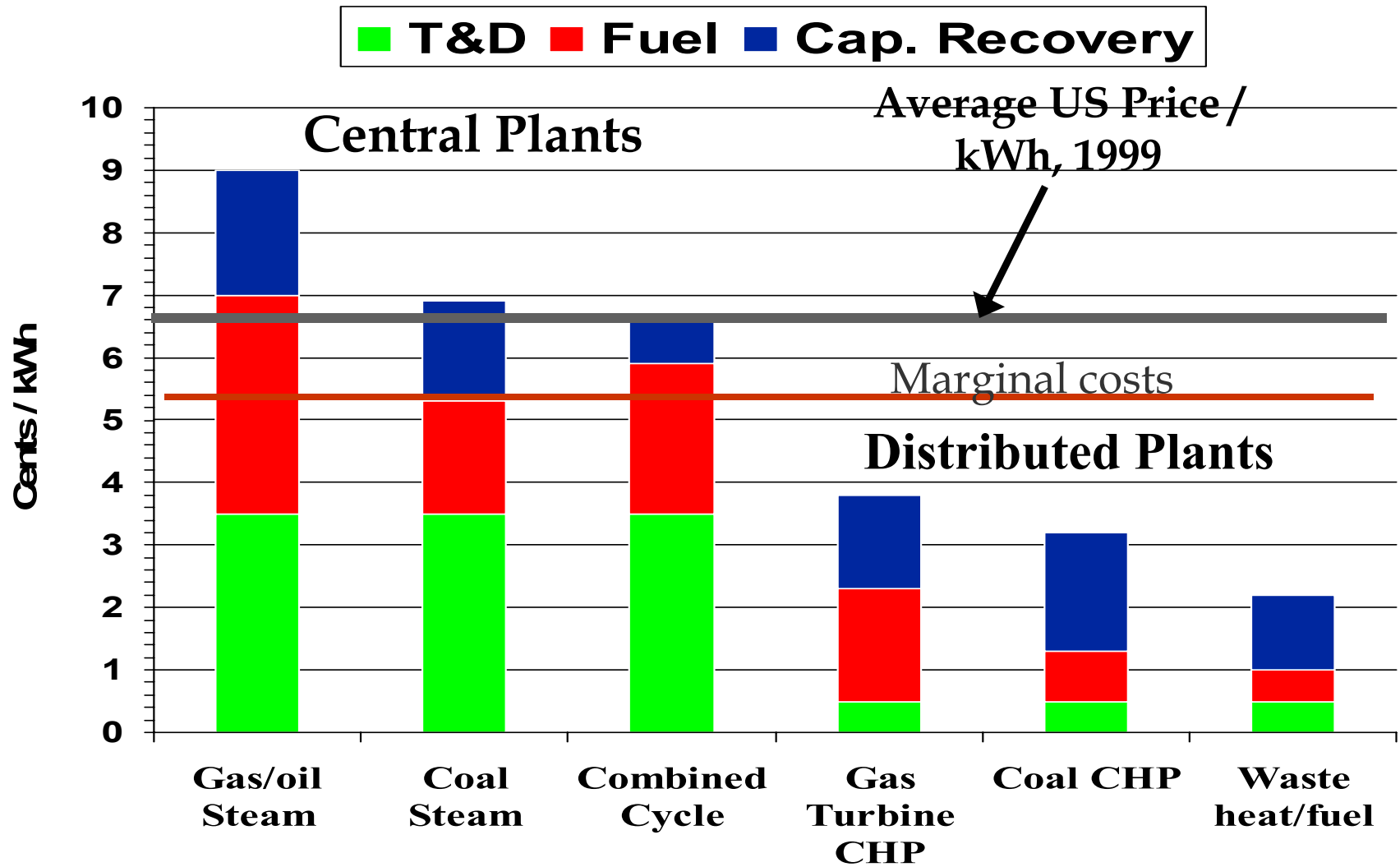
US Real Prices of Electricity ('96 \$'s)



Two Cost Benefits of DG

- CCGT plants cost \$500/kW, compared to DG plants at \$1000/kW
- CHP fuel savings 1 to 1.5 cents per kWh or \$80 to \$120 per year – **just pays extra capital**
- But new central plants need new T&D, adds \$1300 / kW of new capital
 - Users will pay power cost plus 3 to 3.5 cents per kWh for power delivery from central plants, but pay only for power from DG – **save 3 to 3.5 cents.**

All In Cost/kWh – 6 Plant Types



Capital Savings From DG

- Assume demand grows same as '89 - 2000
- The US has two ways to meet needs:
 - 1) Build all new generation central -- \$84 billion for plants, \$220 billion for T&D, total \$304 billion
 - 2) Build all new distributed generation -- \$168 billion for new plants, \$0 for T&D, **save \$136 billion**

Good Questions

- **Are there sufficient opportunities for CHP?**
 - Easy to find 200,000 MW
 - (FERC 1978 estimate was 5000 MW maximum)
- **Will large users leave the system? Will this raise prices to small users?**
 - Yes, some will leave, but this will drive prices down to all, central plants will recycle heat to compete
- **If private wires are allowed, will there be many new wires?**
 - No, but threat will end this major barrier to DG

Benefits Summary of New DG Paradigm

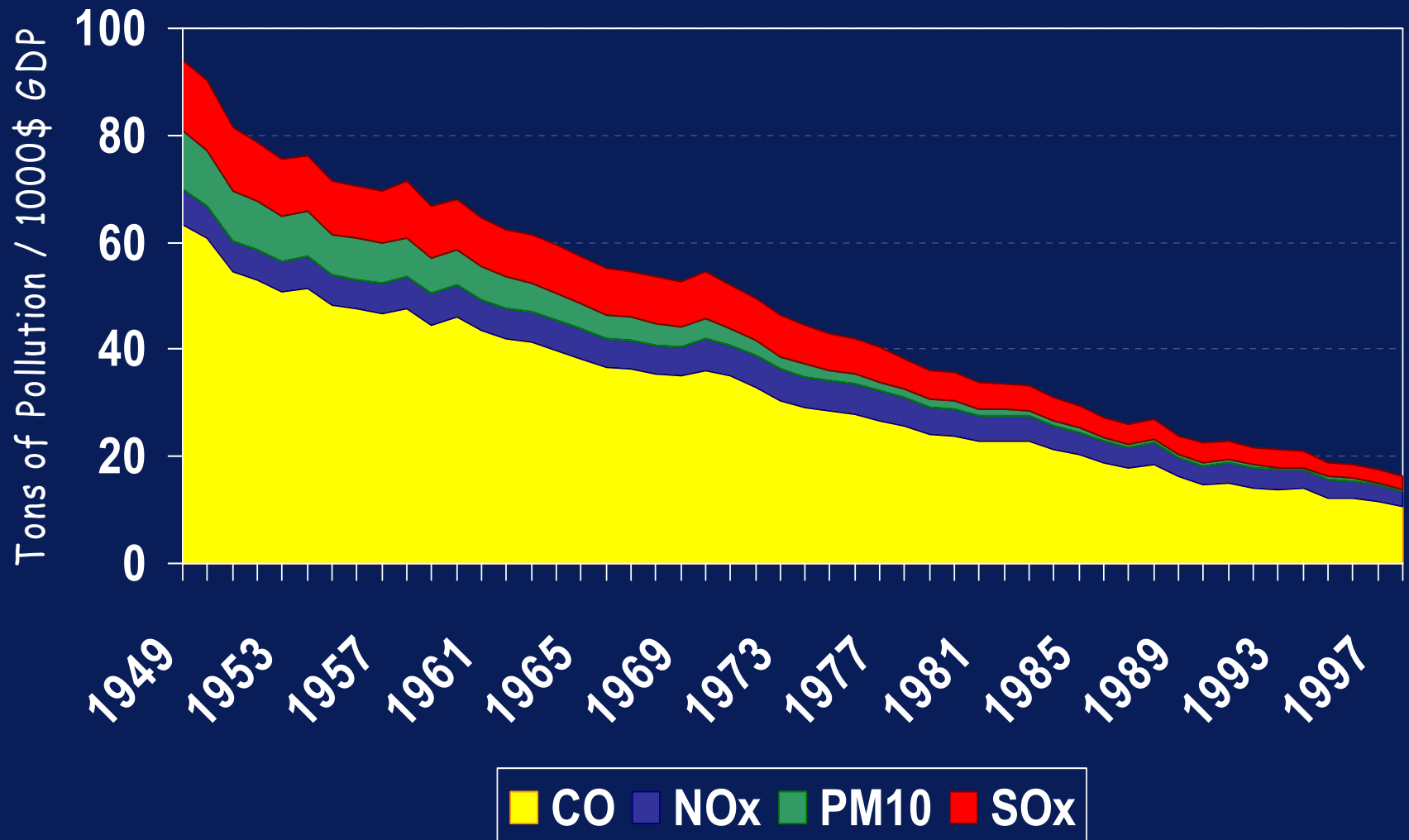
- **With barriers removed, DG will be built until power prices drop to 4 cents / kWh. (2.5 P)**
 - This will drive out expensive power and save \$110 billion / year
- **Using DG for primary and secondary supply to critical users will cut costs of power quality in half, saving \$60 billion/year (38 billion pounds)**
 - **Total savings = \$170 billion/yr.**
 - **DG will cut fuel use and CO₂ by 20%**
- **Interconnected DG will reduce vulnerability**
- **DG will clean the air as a bonus**

Conclusions

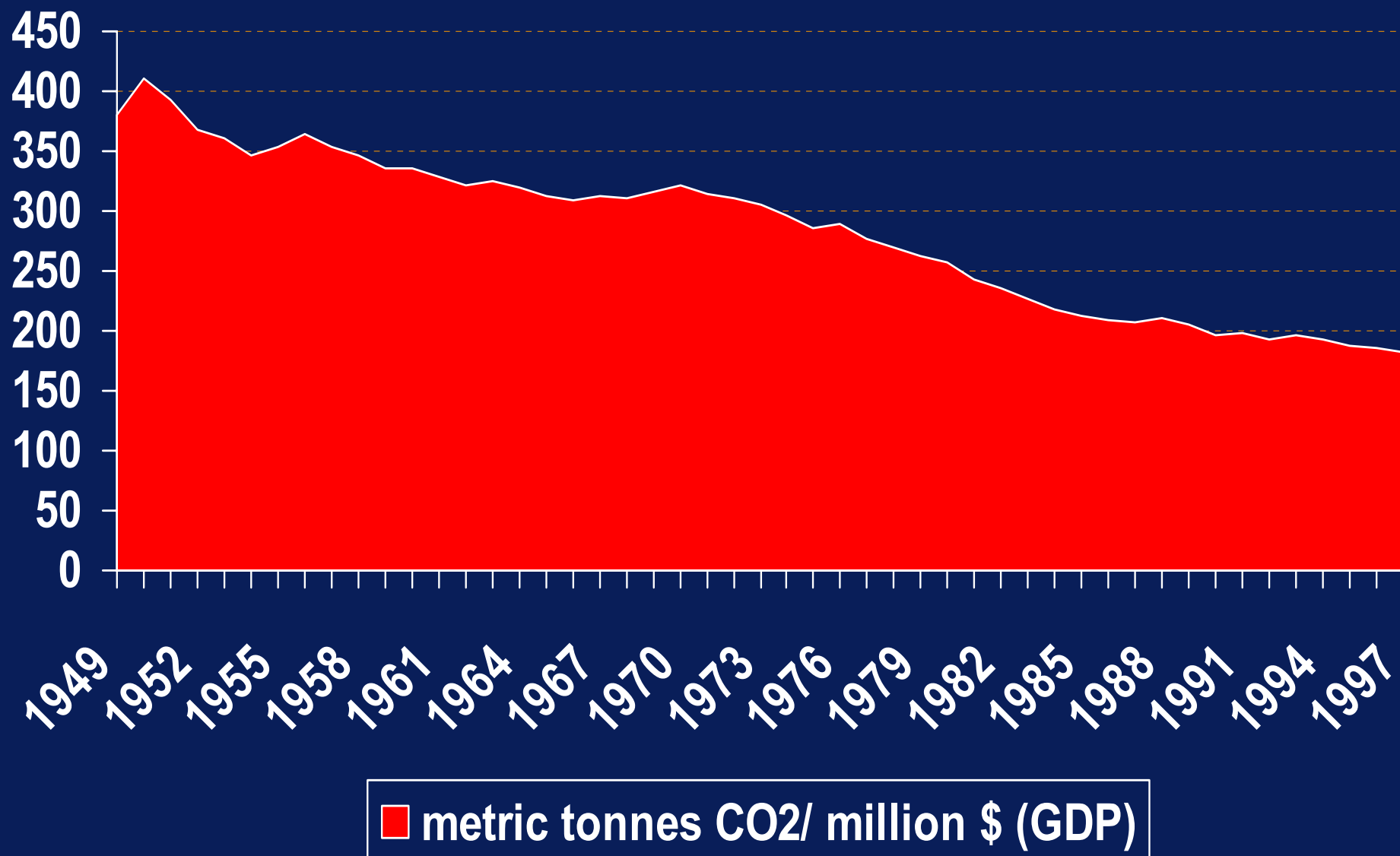
- **There have been encouraging trends, but,**
 - **Total reliance on central generation is causing problems -- the system is not optimal**
- **Transforming electricity to a DG/hybrid system will mitigate energy, environment and economy related problems.**
- **US can lower energy costs and clean the air by deploying efficient on-site generation**

***Thank you for
Listening***

Tons US Pollution / million \$ GDP



US CO₂ Tonnes per Million \$ GDP



Central Vs. Distributed Generation Capital

■ Cent. Gen, T&D ■ Dist. Gen

